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Analysis of possible influence on pigments after applied electrochemical desalination

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Salt induced surface deterioration is considered as one of the biggest threats against future preservation of murals. Electrochemical desalination has in previous work been shown to be an effective method provided the salts have been dissolved as this enables transport in an applied electric field. It is also well-known that in case of non-controlled electrode processes during electrochemical desalination the pH of the adjacent material will change pronounced [1]. When applying the electrochemical desalination method to structures with murals it is of predominant importance to ensure an absence of pigment changes in the murals. However, a possible influence of the applied electric DC field on the pigments could be 1) reactions of the ions the pigments consist of or 2) transport of the pigments if present as charged ions. To analyse whether these surface phenomenons occur is the object of the present work.
Possible influence on pigments caused by electrochemical desalination was investigated for natural ochre (a clay feature combination of ions containing up to 60 wt% oxides of ions) with varying pigment firing degree and thereby colour intensity. Natural ochre was chosen as this pigment over the centuries was often used and because it contains combinations of ions which through reactions can result in colour changes. By contact with HCl ochre can partly dissolve and react into $FeCl_3$ (ferric chloride) which has a dark green colour and it is known that contact with acids of sulphur can result in a faded colour intensity. In the present study brick specimens with the dimensions of 5 cm × 5 cm × 5 cm was added a lime layer completed with a layer of natural ochre (fired at 0 ◦C, 600◦C, 1100◦C or 1200◦C) in fresco technique.
In addition possible transport of pigments in an applied electric field was investigated with identical brick species were the used pigment was CuCl pigments.

An initial overview of possible changes of the pigments was made with high resolution macro pictures (macro lens, Nikon D 610 (24 Megapixel) and Kaiser RB 5000 Daylight Copy Light Set). Energy-dispersive X-ray spectroscopy **(**EDX**)** mapping was carried out for determination of a percentage-wise change in pigment, limelayer and brick as in [2]. The initial macro pictures visualised a non-homogeneous painted surface (picture 1) which was made more clearly with the topography pictures made with scanning electron microscope (SEM), (figure 2). This is to be dealt with in the EDX mappings to trace eventual changes in the percentage-wise contents by analysing multiple spectrums until a stable average percentage-wise content of each element was found (figure 3).
After electrochemical desalination the brick specimens were investigated and compared with identical reference specimens for investigation of whether the applied electric field for desalination affects the pigments.

References

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[2] Cavallo G., The Blue Pigment Used in Vallemaggia (Switzerland) in the Half of 19th Century by Painters Vanoni and Pedrazzi. Microchim Acta 155, 121-124 (2006).

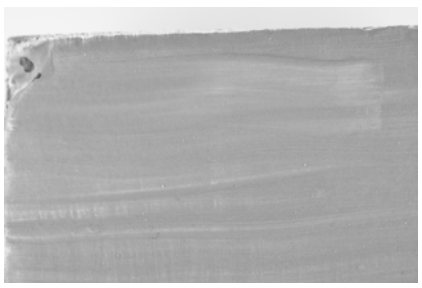
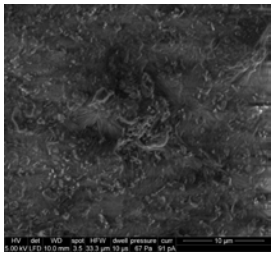


Figure 1 Macro picture, reference, ochre fired at 0˚C



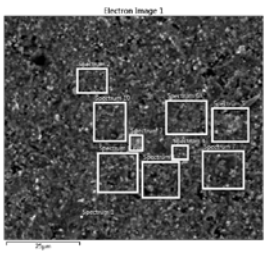


Figure 2, middle, Topography, reference, ochre fired at 0˚C
Figure 3, right, Spectrums for EDX analysis, reference, ochre fired at 0˚C